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IRRIGATION MANAGEMENT TRANSFER ISSUES IN TURKMENISTAN

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Contents

Section Page

INTRODUCTION

The authorization for conducting this study comes from the Environmental Policies and Institutions for Central Asia (EPIC) Program of the US Agency for International Development Central Asian Republic (USAID/CAR) Mission which is implemented as a Task Order under the USAID Global Environment Center's Environmental Policy and Institutional Strengthening Indefinite Quantity (EPIQ) Contract.

Assistance is being provided to the Government of Turkmenistan in the areas of irrigation management transfer (IMT) and agricultural economics. The purpose of this investigation is to assess the state of the agricultural sector, with a focus on the irrigation system, in Dashowuz Velayet, Turkmenistan.

The focus of this report is to present the results of an assessment of the current capacity of the irrigation sytem, including the drainage component, to sustain irrigated agriculture of the Dashowuz Velayet over time.

SETTING

The Dashowuz Velayet is the largest of the five administrative regions of Turkmenistan. It has a population of approximately one million, which is about one-fifth of the national total. One third of the population live in urban centers with the City of Dashowuz being the largest with a population of about 160,000. There are eight administrative subregions, called etraps, with populations ranging from 10,000 to about 35,000. The remainder of the population live on Daikon farms, which were the collective farms of the Soviet era.

The Importance Of Agriculture To The Economy

Agriculture is clearly the most important sector of the Dashowuz Velayet economy. Due to climatic conditions and the lack of local water sources, agriculture is totally dependent on irrigation water diverted from the Amu Darya River. The distribution of employment among the economic sectors, which has remained fairly constant over the past several years, is presented in Table 1.

Table 1: Distribution of Employment among Economic Sectors
(Percent of Total Employment in 1995)

Economic Sector	Percent
Industry	4.9
Agriculture	52.2
Transport	3.5
Construction	8.2
Trade/Food	4.1
Housing and Communal Service	1.7
Health Care & Social Protection	6.6
Education	13.9
Other	4.7
Total	100

Source: World Bank, Regional Development Priorities, Main Report Vol. II, Dashkhovuz, Turkmenistan, Report No. 17737-TM, September 9, 1998.

Agriculture is certainly the dominant economic sector in the Dashowuz economy. Since all of agriculture in the velayet is dependent upon irrigation, the economic vitality of the velayet us directly dependent on the effectiveness of the irrigation system in delivering the needed quantities of water at the times they are needed to the places they are needed.

The Dashowuz irrigation system was started over two centuries ago. During the Soviet era, Dashowuz produced about 50 percent of the Soviet rice. That required intensive irrigation, but did not require drainage. Large tracts of new land were later developed for cotton production, there was a need to install a drainage system at the same time. That was not done. A collector system was installed later with all drain water eventually ending up in Sarakamish Lake, a huge terminal lake lying about 300 km west of Dashowuz.[1]

Furthermore, in order for agricultural productivity to be sustained over time, the irrigation system must perform its many tasks without adversely impacting the productivity of the soil. Without adequate soil drainage, the fertility of irrigated soils can not be sustained due to the resulting increase in soil salinity. Therefore, for the productivity of any irrigation system to be sustainable over time, it is necessary to have an effective drainage system as an integral component of the overall irrigation system.

There are 460,000 ha reported as being developed for irrigation. However, during the past few years the cultivated area has been about 400,000.[2] Table 2 presents the distribution of land, by etrap, that has been developed for irrigation.

Table 2: Distribution of Developed Irrigated Area (1996)

Etrap	No. of farms	Irrigated Area (ha)
Dashowuz	16	62,570
Taxta	19	64,015
Yilanly	13	55,867
Ackdepe	19	66,416
Boldumsaz	9	28,345
Gubadagh	14	39,455
Kune-Urgench	22	59,140
Turkmenbashi	26	82,467
Total in Velayet	138	458,275

Note: Farms have been redesignated as Daihons and are being divided among leaseholders.

Cotton is by far the most important crop in the velayet. Wheat has become the second most important crop since the government adopted a program to attain self-sufficiency in wheat production. Table 3 presents cropping patterns for selected years by hectares.

Agricultural productivity in the velayet has been declining in recent years to the point that it is far below the historically proven potential. This has placed a severe economic burden on the residents of the velayet in general and the farmers in particular.

[1] Interview of the Assistant Hakim in charge of finance, Dashowuz Velayet, 15 May 99.
[2] World Bank, Regional Development Priorities, Main Report Vol. II, Dashkhovuz, Turkmenistan, Report No. 17737-TM, September 9, 1998.

Table 3: Cropping Patterns for Selected Years

Crop	1991	1994	1997
Alfalfa	18460	21082	24941
Cotton	175400	181200	175800
Maize (grain)	n/a	11170	11000
Maize (silage)	12720	12940	11000
Melons	2750	4134	2450
Orchards	1142	1205	1233
Potatoes	n/a	479	1000
Rice	n/a	33570	33200
Vegetables	1280	2720	2080
Vineyards	200	264	164
Wheat	n/a	61862	69500
Total	211952	330626	332368

Source: Dashowuz Department of Agriculture, 1997. (Note: The totals are far below the reported 400,000ha of cultivated area.)

Prior to 1996, cotton yields ranged from 2.0 to 2.3 tons/ha. In 1996, cotton yield dropped to an average of 0.8 tons/ha in the because of several factors including a short water year, infestation of white flies, and questionable quality of seed and fertilizer. The range of yields realized since 1996, as reported in interviews with water management officials, is back to 2.0 to 2.3 tons/ha. However, interviews with farmers indicated yields for cotton typically run from 1.5 to 2.0 tons/ha in the Dashowuz Velayet.

Productivity for wheat, the other major crop, is not any better. Wheat yields are running about 1.5 tons/ha. That compares to about 5.0 tons/ha in the rain-fed areas of Central Europe and 7 to 8 tons/ha in Western Europe.

There is strong evidence that increasing soil salinity is the primary physical cause for low productivity. There also is evidence that institutional policies such as administratively dictated crop quotas, output prices, and input availability contribute to the low agricultural productivity. Yields for cotton and wheat are expected to be low again this year due to poor quality seed for both crops and the wheat crop is showing evidence of disease problems.

THE IRRIGATION SYSTEM

In this report, the irrigation system is presumed to include the physical facilities making up the supply, deliver, and drainage subsystems and the organizatiional entities necessary to carry out management, operation, and maintenance of the system.

Supply and Delivery Facilities

The only supply of irrigation water for the Dashowuz Velayet comes from diversions from the Amu Darya River in a 150km stretch of the river downstream from the Sutansadjar and Tuyamuyun reservoirs. The Tuyamuyun hydropost, immediately below the Tuyamuyun reservoir, is the key point for measuring water and salinity levels for diversions to Dashowuz. These diversions occur in Uzbekistan and are transported through transboundary facilities that are operated in accordance with written agreements between the countries. The transboundary canals continue into the Dashowuz Velayet as major suppliers of water. Average salinity levels of this water range from 0.5 gr/l to 0.9

gr/l. Soils supplied by water of that salinity must have adequate drainage to maintain productivity.

Transboundary Facilities

There are four major diversion points on the Amu Darya River in Uzbekistan that supply water to the four large canals serving Dashowuz. Table 4 identifies these canals and their design capacities.

Table 4: Transboundary Canals Serving the Dashowuz Velayet

Canal	Design Capacity (m^3/sec)
Gazavat	80
Shavat	160
Klich-Niaz	60
Xanyap (Soviet-Yab)	180
Total	480

Source: World Bank Report No. 17737-TM dated September 9, 1998.

The Xanyap canal serves 208,000 ha in Dashowuz velayet and the other three serve the remaining 252,000 of the 460,000 developed ha.[3] These four transboundary canals deliver water to an extensive system of conveyance and distribution canals within Dashowuz velayet that serve the eight etraps.

Dashowuz Inter-etrap Conveyance Facilities

There are over 3000 km of conveyance and distribution canals within the eight etraps. None are lined. Water distribution is controlled by gated control structures. There is no reservoir within that distribution system. Table 5 presents the lengths of conveyance and distribution canals within each etrap.

Table 5: Length of Conveyance and Distribution Canals (1996)

Etrap	Length of Canals (km)
Dashowuz	270
Taxta	195
Yilanly	313
Ackdepe	389
Boldumsaz	178
Gubadagh	156
Kune-Urgench	336
Turkmenbashi	608
Inter-state/Inter-etrap	617
Total	3062

Source: World Bank report no. 17737-TM dated September 9, 1998.

On-farm irrigation systems

Most of the farm canals have no regulation capacity and there is virtually no flow measurement capability. There are no storage reservoirs on the farms. Most farms must pump from secondary distribution canals to get water into smaller field canals. Parameters of the on-farm irrigation canals are presented in Table 6.

[3] In an interview with the Head, Boldumsaz Water Economy on 17 May 99, it was reported that the Xanyap Canal has a capacity of 250 m^3/sec.

All irrigation is by conventional surface methods such as furrow, wild flooding and, to a lesser extent, some basin and border irrigation.

Table 6: On-farm Irrigation Canals (1996)

Etrap	Length of Canals (km)	Length of Canals (km)	Average Density Of Canals (m/ha)
Dashowuz	62570	1022	16.3
Taxta	64015	2914	45.5
Yilanly	55867	298	5.3
Ackdepe	66416	925	13.9
Boldumsaz	28345	151	5.3
Gubadagh	39455	435	11.0
Kune-Urgench	59140	1598	27.0
Turkmenbashi	82467	1203	14.6
Total	458275	8546	18.6

Source: World Bank report no. 17737-TM dated September 9, 1998.

Drainage Facilities

All drainage water eventually ends up in Sarikamish Lake which is a huge terminal lake at the extreme west end of the velayet. An extensive drainage system collects the drain water and channels it into two large collector drains, the Ozerny and the Daryalyk. Peak flows as high as 450 m^3/sec have been released into Sarikamish Lake. Approximately half of the drain water that reaches the lake comes from the Khorezm region in Uzbekistan. The salinity of the drainage water ranges from 3 to 4 gr/l. The salinity of Sarikamish Lake water is about 10 gr/l. Drainage water is not considered suitable for irrigation; however, during periods of serious water shortage some drainage water has been used to irrigate small pasture areas.

When the main collector drains are full which, is often the case, flows from the minor drainage channels are restricted from entering the collectors, resulting in rising water tables. Table 7 presents the lengths of collector drains by velayet.

Table 7: Length of Collector Drains (1996)

Etrap	Length of Canals (km)
Dashowuz	278
Taxta	313
Yilanly	451
Ackdepe	300
Boldumsaz	196
Gubadagh	135
Kune-Urgench	529
Turkmenbashi	426
Inter-state/Inter-etrap	668
Total	3296

Source: World Bank report no. 17737-TM dated September 9, 1998.

Approximately 230,000 ha of the total irrigated area has drainage conveyances installed. That constitutes about 50 percent of the area. The World Bank reports the recommended

amount of on-farm drain length should be between 30 and 40 m/ha. Table 8 shows that the actual average length is generally below that. [4]

Table 8: On-farm Drains (1996)

Etrap	Irrigated Area (ha)	Length of Drains (km)	Average Density of drains (m/ha)
Dashowuz	29900	529	17.7
Taxta	28000	844	30.1
Yilanly	28800	591	20.5
Ackdepe	32100	743	23.1
Boldumsaz	16900	537	31.8
Gubadagh	24300	661	27.2
Kune-Urgench	35400	916	25.9
Turkmenbashi	33900	851	25.1
Total	229300	5672	24.7

Source: World Bank report no. 17737-TM dated September 9, 1998.

Organizational Structure of Water Management

The Ministry of Land Reclamation and Water Management (MLRWM) has the responsibility for all irrigation water management from the point of delivery to Turkmenistan up to delivery to the farms. Chart 1 illustrates the general structure of water management authority.

Transboundary Management

The transboundary canals and collectors are under the general management of the Amu Darya Basin Water Association (BVO), which is an inter-state body created and controlled by written agreements between the Presidents of the four riparian republics, Kyrgyz Republic, Tadjikistan, Turkmenistan, and Uzbekistan. The actual operation and maintenance of the transboundary facilities serving Dashowuz is carried out by Upradik, an Uzbek water management entity.

Dashowuz Water Economy

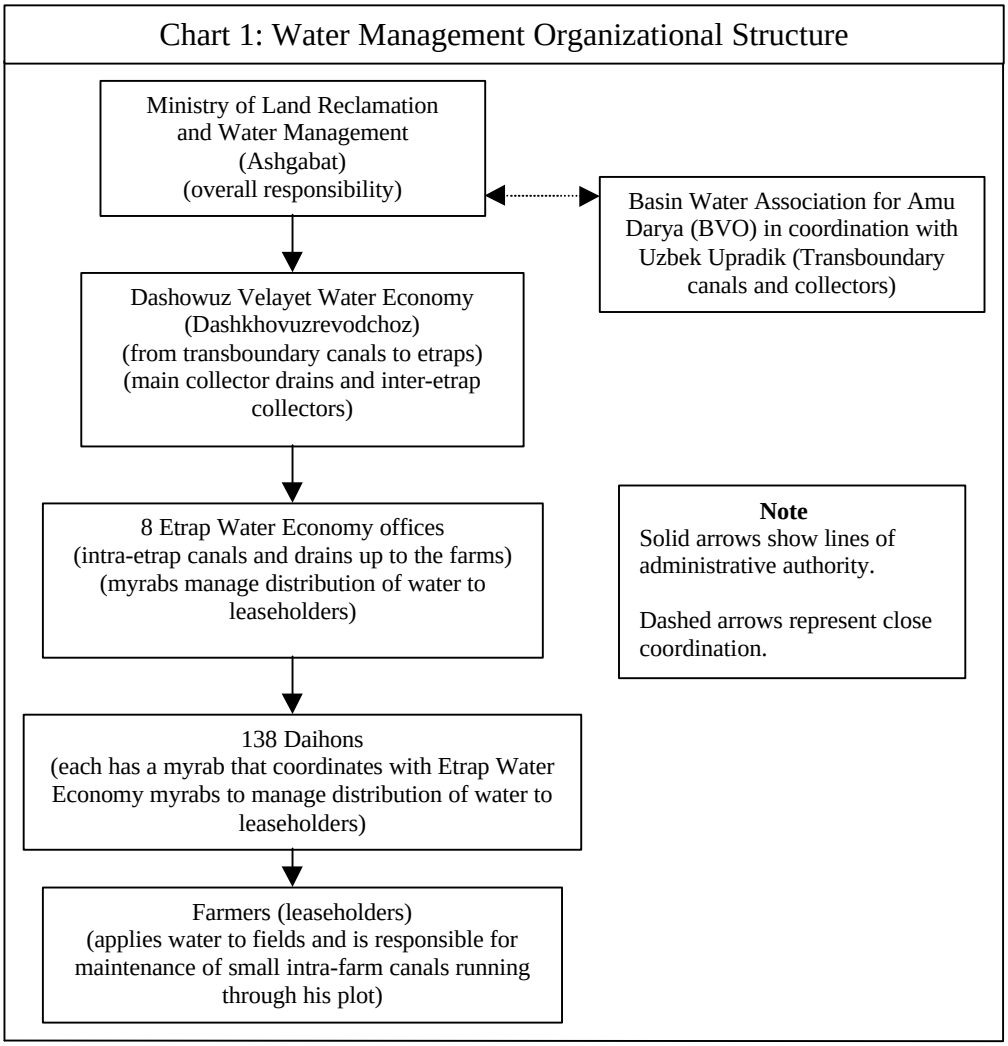
The Dashowuz Water Economy (Dashkhovuzrevodchoz), sometimes known as the Dashowuz Water Association, is an arm of the MLRWR located in the City of Dashowuz. It has direct managerial responsibility for the inter-etrap irrigation system in the velayet and indirect responsibility for the intra-etrap facilities which it administers through its subordinate Etrap Water Economy offices.

Daihon Associations

Daihons, which are the former collective farms (kolkhozes), are presently in a state of flux. They have recently had the responsibility of supervising intra-farm water distribution, among other responsibilities. They did this through myrabs (hydro-technicians) that worked closely with myrabs from the Etrap Water Economies to ensure

[4] In an interview on 13 May 99 with Usman Saparov, Head, Hydrogeological Melioration Expeditions, Ministry of Agriculture and Water Resources, it was reported that the irrigated land in the Dashowuz velayet need an average of 70 m/ha of drainage facilities and they currently have only 22 m/ha.

that the proper water deliveries were being made. However, recently the Daihon myrabs have been transferred to the Etrap Water Economies. That leaves the Daihons without any direct representatives to ensure the proper delivery of water to the farmers. It has been reported that the Daihons are being disolved, even though many are still functioning. If that is true, the farmers will be left without any collective bargaining power which will exacerbate the need for water user associations.



Farmers

Farmers, or leaseholders, have 10 ha to cultivate, but not necessarily the same 10 ha each year. Therefore, there is little incentive to improve productivity beyond the present year. Leaseholders have the responsibility of irrigating, weeding, and thinning the crops as needed. Planting and harvesting of quota crops (cotton and wheat) is done be contracted machinery services. They also have the responsibility of maintaining the lowest level of intra-farm canals that cross their plot of land by keeping them free of weeds and sediment. However, their primary resource for doing that is their own hand labor. It is understandable that, with limited resources and little incentive for increasing long-term productivity, leaseholders concentrate on getting in this year's crop without much consideration for the future.

PRESENT CONDITIONS

The description of present conditions of the irrigation system is based a reconnaissance survey of the study area conducted by the study team during the period of May 14 to May 25, 1999. Clearly the intensity of the effort was not sufficient to make a detailed assessment of such an extensive, complex system. However, some conditions were obvious and it is those conditions that are emphasized herein.

Transboundary Facilities

The transboundary canals have the capacity to deliver the allocated water supplies. However, when the team visited the diversion site on the Amu Darya River for the largest transboundary canal, it was observed that there is no diversion structure on the Amu Darya at that site with which to raise the level of water in the river to ensure the allocated amount of water can be diverted. The flow into the canal is strictly run-of-the river. That is, if the flow in the Amu Darya is high, flow into the canal will be high. If the Amu Darya flow is low, the flow in the canal will be low. Also, the out-take site was heavily sedimented. A dredge works continuously to keep the canal inlet open.

In an interview with the director of the Taxta Etrap Water Economy, it was reported that the major challenge facing their office is low inter-state flows. He stated that sometimes the flow is low because too much water is being diverted in Uzbekistan. When complaints are lodged with the Interstate Committee it takes about three days for them to be resolved.

Delivery System Facilities

There is an extensive system of distribution canals that take water from the main transboundary canals and deliver it to the eight etraps. The total length of these canals os over 3000 km. None of these canals are lined and there are no storage facilities. Control is maintained , to the degree that it can be without storage capacity, by gated control and diversion structures. The lack of storage capacity, leakage from the canals, condition of the control gates, and lack of accurate water measurement limits the ability to deliver precise quantities of water.

Ability to deliver water

Canal leakage is a major problem with delivery efficiencies ranging from 50 to 60 percent. The average delivery efficiency in the Yilanly etrap was reported to be 52 percent. These low delivery efficiencies force excessive diversions in order to meet irrigation requirements. That increases the leakage and contributes to the high water table and, consequently, to the increasing soil salinity.

The ability to deliver precise amounts of water is also limited by the condition of the control gates. The larger gates were designed to be power driven. However, many of the drive motors are inoperable or even missing. Many of the threaded shafts that control the gates indicate that the position of the gates have not been changed in a long time. There is no evidence of lubrication and they are heavily rusted. A few of the shafts were even bent to the degree that they could not be adjusted. It appears that the gates have been set to what experience has shown to be reasonably satisfy normal operating conditions and they have remained in those positions for months, maybe years.

In the Yilanly Etrap, it was reported that the entire area is served by pumping from the Shabat Canal. However, only 40 to 50% of the pumps are operational. Repairs are funded by the budget, but there is not enough funds for parts and maintenance.[5]

Water measurement

Water measurement is primarily done with staff gauges calibrated to flows through known cross-sections using flow meters. That is a conventional and acceptable way to obtain reasonable measurements of irrigation water assuming that something on the order of a concrete weir is used to stabilize the calibrated cross-sections. Also, the staff gauge used to calibrate the flow should be mounted in the stabilized cross-section. However, that was not the case with any of the measurement sites observed. At best, the cross-sections were maintained with riprap and the staff gauges that were observed were positioned downstream from the cross-sections in unlined areas that suffer from bank erosion and channel sedimentation. Those conditions make it extremely difficult to maintain calibration standards.

On-farm conditions

Increasing soil salinity caused by high water tables is the primary direct cause of low crop productivity. The primary on-farm water-supply related cause is excess application of irrigation water coupled with inadequate on-farm drainage systems. The irrigation rotation periods are generally 10 to 15 days, but in the Turkmenbashi etrap, the irrigation rotation is fron 15 to 20 days. To minimize stress on the crops during such long periods between irrigations, farmers tend to apply excessive amounts of water out of necessity.[6]

Drainage System Facilities

There are five major collector drains serving Dashowuz, two large ones with capacities of 120 to 150 m^3/sec and three with 30 to 40 m^3/sec. There are approximately 9,000 km of collector drain channels in the system. Transboundary collectors total about 670 km in length. There are about 2600 km of inter-communal collectors and about 5700 km on intra-communal collectors. Problems with these collectors are primarily siltation and depth. Siltation is a continuing problem that reduces the capacity of the collectors and the collectors are too shallow to adequately receive water from the on-farm drains.

There is some uncertainty about the extent of the on-farm drainage system. The previously cited World Bank report states that the recommended on-farm drain length is between 30 and 40 m/ha. In an interview with the head of the Hydrogeological Melioration Expeditions, MLRWM, it was reported that an average of 70 m/ha are needed and there are only 22 m/ha installed. The World Bank report also states that these drains have been neglected to the point that most open drains are silted and overgrown with weeds and the closed drains have not been flushed for years and almost all are reported to be non-functional.[7]

[5] Interview with the Head and staff of the Yilanly Etrap Water Economy, 18 May 99.
[6] In an interview with the Chief Hydrogeologist, Turkmen-Turkish joint enterprise, SENAGATSUV, it was reported that farmers at the head-end of delivery canals tend to over irrigate by as much as 20 times their allotment.
[7] Op. cit., page 39.

About 200, 000 ha have a water table less than 2.0 meters and about 98,000 ha have a water table less that 1.5 meters. With such high water tables, high soil salinity is unavoidable. Approximately 65,000 ha have heavy salinity levels, over 200,000 ha have medium salinity levels. There are about 185,000 ha that are not satisfactory for production due to current salinity levels.[8] Salinity levels could be reduced if the drains were properly maintained, but there is not sufficient funding to conduct the needed level of maintenance. A lack of operational maintenance equipment is the primary deficiency.

Operation and Maintenance Equipment

The primary operation equipment is the many control gates on the delivery system and pumps to lift water from the delivery canals to the smaller farm canals.

The large and medium sized gates are designed to be operated by electric motors. Small gates are hand operated. Many of the motors are non-operational and some are missing entirely. As a result, those gates tend to remain set at levels that provide adequate service under average normal conditions. That does not allow for fine tuning deliveries to obtain maximum delivery efficiencies.

Pumps for lifting water to the farm canals are generally electric powered. In the Yilanly Etrap, where all delivery to farm canals is by pumping only about half of the pumps are operational. In the Turkmenbashi Itrap, it was observed that some electric pump motors had failed and had been replaced with diesel motors. The motors are old, require continuous maintenance by mechanics, and are expensive to operate. Access to spare parts is limited.

Draglines of Russian design are the primary equipment for cleaning the canals and drains. The newest equipment they have was reported to be 12 years old. The supply of parts from Russia has dried up. Specific reasons were not given. The interview with the Taxta Etrap Equipment Station revealed that only 80% of their heavy equipment are operational due to a lack of spare parts. It was reported that the Yilanly Etrap Water Economy has 26 draglines, but only 11 or 12 are operational at any one time. Cannibalization from the non-operational machinery is the primary source of parts to keep the operational inventory functioning. However, the operational inventory is progressively declining. There is no funding for repair or replacement of this equipment.

Lack Of Funding For Proper Operation, Maintenance, And Reconstruction

Funding for the level of operation and maintenance programs that would assure reaching and sustaining acceptable levels of productivity is not available. There are three potential sources of funding for O&M, the state budget, water users, and external financing sources. The state budget is currently the primary source of funding. Water users provide some funding indirectly through what constitute production taxes. Neither of these sources nor the combination of them provide enough revenue to carry out an effective O&M program. External financing sources can not be relied upon for

[8] This information was obtained in an interview with the Deputy Hakim, Dashowuz Velayet on 15 May 99.

continuing O&M funding, but could be an important source of funds for securing equipment for carrying out O&M activities.

It is recognized that many of the drains must be reconstructed to be more effective. That is an agenda item scheduled for the June 10 meeting of the Intergovernmental Coordinating Committee on Water Resources. However, the prospects are not good due to lack of funds and the non-existence of construction machinery.[9]

Funding from the State Budget

Currently, the state budget provides for little more than the payment of salaries and retirement. About 40 percent of the funds needed to implement O&M plans for collectors and drains are allocated, but only 50 percent of the 40 percent are actually received.[10]

Funding from water users

Funding from water users comes in the form of taxes on production from the quota crops, cotton and wheat. Cotton and wheat are harvested and then marketed through government offices in Ashgabat. Twelve percent of the value of total production is taken in the form of what constitutes a tax on production. That money is then distributed by the government to the Daihons to be used for the following purposes:

- 25% goes to support of the general economy
- 10% for specialized labor
- 40% for social needs
- 25% to irrigation and collector maintenance (25% of 12% results in 3% of value of total production going for this purpose)

However, last year the amount for irrigation and collector maintenance was reduced to 1.5% due to very low production to avoid an excess burden on the farmers.[11] This indicates that, of the services provided by the 12% production tax, maintenance of the irrigation and collector system has a low priority.

The remaining 88 % of the goes to payment of production expenses with any net going to the farmers. Production expenses are netted out of the line-of-credit provided to the farmers by the Daihon banks at the beginning of the crop year. From a share basis, it sounds like 88% would assure a good return to the farmer. However, the prices paid for the crops, 1000 manat/kilo for cotton and 400 manat/kilo for wheat, are far below open market prices. At these prices, a farmer must get a yield of 2.0 tons/ha in order to net one million manat/ha.[12] However, interviews with farmers indicate yields in Dashowuz have been running in the range of 1.5 to 2.0 ton/ha during recent years and in 1996 the average yield was only 0.8 ton/ha.

Even at the quota yield of 3.2 ton/ha, which the World Bank report indicates is unattainable, net return would be about 2.2 million manat/ha.[13] With an average of 2 ha of cotton allocated per farm, that equates to a dollar equivalent income ranging from $420 to $130, depending on official or market exchange rates. Considering that there is an

[9] Interview with the Deputy Minister, Ministry of Agriculture and Water Resources, and Chairman of the Executive Committee on 12 May 99.
[10] Interview of the Assistant Hakim in charge of finance, Dashowuz Velayet, 15 May 99.
[11] Interview of Deputy Director, Water Association, Ashgabat, on 11 May 99.
[12] One million manat would be equal to $192 at the official rate and only about $59 at the market rate.
[13] Op. cit. World Bank report, pp. 20-21.

average of 7 persons per farm family, that equates to from $60 to less than $20 per capita income from cotton. Wheat production is even less profitable.

With such low net return to farmers, it is clear that water users do not represent a promising source of funding for O&M of the irrigation system.

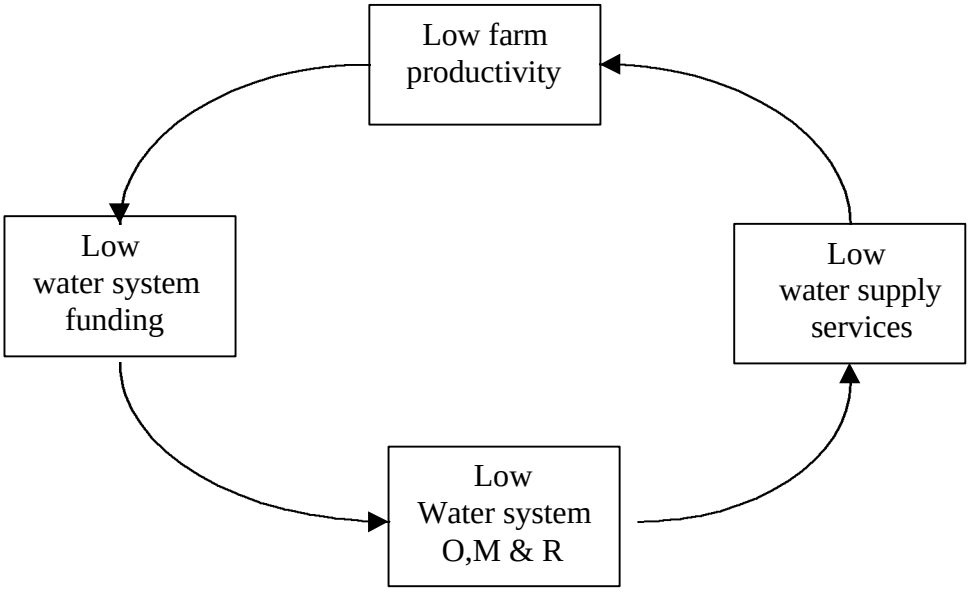
Funding from external sources

It is likely that the primary concern of potential suppliers of external funding is the assurance of repayment. Such assurance is unlikely given the general condition of the irrigation system and the lack of physical and financial resources to improve those conditions. It seems that the Dashowuz irrigation economy is caught in a cycle of financial deficiency.

Financial Crisis

There is a financial crisis that permeates the water economy. The following chart depicts that cycle of financial deficiency.

Irrigation Economy
Cycle of Financial Deficiency



It is debatable what point in the cycle is the primary cause of the deficiency, but the deficiencies in ability to pay at the farm level are caused by more than just low water supply services.

It is clear that there are deficiencies at all points in the irrigation economy. Farm productivity is low and prices for quota crops are administratively set far below open market values; therefore, financial assessments extracted from farmers is low. Funding from the state budget is low relative to the need. Consequently, performance by water managers is low because of lack of resources to meet their responsibilities.

Improvements in any one area will require considerable lag time before the effects are felt in other areas of the irrigation economy. Therefore, it should be equally clear that the

most expeditious solution would require a comprehensive approach that impinges on all points simultaneously.

RECOMMENDATIONS

Two seminars were held to present and discuss the findings of this study. A two-day seminar has held in Dashowuz with local officials, specialists, and farmers. Feedback from that seminar was used to refine the conclusions of the consultants which were presented at a one-day seminar in Ashgabat with high-level officials from Ashgabat and Dashowuz.

Recommendations from the Ashgabat Seminar

The Ashgabat seminar produced the following recommendations which were approved by acclamation:

- Explore the establishment of Water Users Associations.
- Explore applying water-service charges.
- Establish a working group to investigate the above recommendations.

There was not time to discuss the specific form the recommendations from the seminar might take; therefore, recommendations that were presented to the seminar by this consultant are presented below as possible points of departure.

Recommendation by the consultant

These recommendations are aimed primarily at improving the level of O&M of the irrigation system. More detailed recommendations aimed at increasing farm profitability and establishment of water users associations are presented in the Consultant Report prepared by Dr. Sam Johnson.

The recommendations that I am presenting fall into two categories: (1) Long-run recommendations and (2) Short-run recommendations.

Long-run Recommendations

Selection of solutions to these very serious problems that Turkmenistan faces require more than the cursory view that we have made. Identification of specific actions to be taken require appraisal-level analyses by teams of specialists to narrow down the range of alternatives on which more expensive feasibility studies will be conducted to select a recommended course of specific actions to be taken. Once the selected course of action has been determined, engineering designs of sufficient detail need to be prepared on which to base bids for performance. The cursory survey we conducted can do no more than identify areas that, in our opinions, warrant further investigation.

Those are:

- Improve water-use-management by:
  - Improving the effectiveness of drainage system.

- Improved O&M and/or reconstruction of the drains.
    - Increased funding from the state budget.
  - Improving canal efficiencies so diversions can be reduced by:
    - Improved O&M and/or reconstruction of the canals.
    - Improve water measurement capabilities.
      - Increased funding from the state budget.
  - Increase on-farm irrigation efficiencies.
    - Shorten the irrigation rotation.
- Concentrate production on the better lands.
- Reduce irrigation to marginal lands.
- Increase farmers' ability to pay for water supply services.
  - Increase product prices at the farm level to encourage increased productivity.
  - Open competitive channels for inputs.
  - Open competitive channels for outputs.
  - Eliminate crop quotas.
- Introduce water service pricing on a volumetric basis enough to encourage water conservation. Requires expanded and improved water measurement capability.
- Seek donor financing for machinery, equipment, and spare parts.

Short-run Recommendations

It is not realistic to presume that sufficient resources can be mustered to do all of the long-run recommendations now. Therefore, in the short-run, the problems should be prioritized, selecting the most serious that can be solved with conventional means that are, for the most part, available domestically. Since the primary causes of low productivity stemming from deficiencies in the water system relate to salinity and inefficient use of water, the problems that contribute to high salinity should be attacked first. Soil salinity is aggravated by a continuously high water table. Following is a list of actions should reduce the water table, and do not require extensive study nor do they require complex engineering solutions. However, they do require increased funding.

<u>Improve the Drainage System</u>

- Identify the stretches of drains with the most serious problems that can be corrected by cleaning and/or minor deepening.
- Assume a two-year period for completing the needed improvements.
- Assess the amount of equipment needed to make the necessary improvements within that period.
- Assess the operational capability of the existing equipment to perform the needed work.
- If the existing operational equipment is inadequate, determine what non-operational equipment can be made operational if spare parts were available.
- Identify the needed spare parts.
- If the resulting inventory of operational equipment is still insufficient, assess what new equipment is needed.
- Document all of your findings.
- Seek funding for the needed spare parts and new equipment.

Improve the Delivery System

- Assume a two-year period for completing the needed improvements.
- Identify the stretches of smaller canals with the most serious problems that can be corrected by cleaning and restoring the design cross-sections. For stretches that have the most serious leakage, after restoring the design cross-sections, line with poly-vinyl sheeting.
- Assess the amount of equipment needed to make the necessary improvements within that period.
- Assess the operational capability of the existing equipment to perform the needed work.
- If the existing operational equipment is inadequate, determine what non-operational equipment can be made operational if spare parts were available.
- Identify the needed spare parts.
- If the resulting inventory of operational equipment is still insufficient, assess what new equipment is needed.
- Document all of your findings.
- Seek funding for the needed spare parts, new equipment, and poly-vinyl sheeting

Improve On-farm Efficiencies

- Assess the capability of the delivery system to handle a modified operational schedule to reduce the length of irrigation rotation. Where the capability exists, make the necessary adjustments in delivery schedules to reduce the length of irrigation rotation. This will not cost anything, it merely requires changing the operating criteria.
- Where the capability of the delivery system is inadequate for reducing the irrigation rotation period, assess what modifications in the system are required to make warranted operational changes.
- Assess the capability of the Water Economy to make those modifications.
- Assess the deficiencies in capability (equipment, skilled manpower, etc.)
- Document your findings.
- Seek funding for resolving the deficiencies in capability.

Increase Funding from the State Budget

Since the general public benefits from a healthy productive agricultural sector, it is appropriate that they help pay for the solutions to the problems facing irrigated agriculture. The most obvious way to do that is through increased allocation from the state budget to the Water Economy.

It has been reported that the allocation from the state budget for operation and maintenance of the Water Economy facilities is sufficient to meet about 40% of the need and less than the full amount of that allocation is actually received. The Turkmenistan economy is now in a state of transition that places heavy burdens on the state budget. The government must allocate limited funds to many competing demands. Irrigated agriculture is the dominant sector of the economy. Every effort should be made to increase the priority for providing funding for an adequate level of O&M of the water economy to match the importance of the sector. The resulting increased vigor of the sector will spread benefits throughout the economy.

Seek Funding from Foreign Donors

Foreign donors are not likely to be willing to provide financial assistance unless they can see that there are tangible assurances that the ability to repay according to the terms of the loan is evident. The proper documentation of the problems, presentation of rational solutions to those problems, along with evidence of irreversible commitment to allowing the functioning of open markets go a long way toward establishing those tangible assurances.

Obtain Funding through Water-Service Pricing

Farmers should pay for water services in proportion to the benefits received. Unfortunately, they are not receiving benefits sufficient to provide significant payment capacity.

During the Soviet era, crops grown, availability and prices of production inputs, and prices paid for outputs were determined by governmental dictate rather than competitive markets. The government was the only supplier and the government was the only buyer for major cash crops. In effect, farmers were salaried government employees that neither suffered from their deficiencies nor gained from their accomplishments. To a considerable degree that is still the case, except the salaries have been terminated. The situation is not likely to improve until farmers can make management decisions in their own self-interest in response to open market conditions.

Increasing farm level prices for production and phasing out of quotas should be the first step in the transition to open market conditions. When that occurs, productivity will increase and farmers will be in a better position to pay for water services.[14]

[14] A form of water service pricing was initiated this year to non-quota crops, i.e., crops other than cotton and wheat. The value of expected production is estimated using average yields and local market prices. Three percent of that value must be paid in advance directly to the Etrap Water Economy. If not paid by a specified time, water will not be delivered. If actual prices and yields differ significantly, a committee will conduct a review to see if adjustments are necessary. It is not clear yet how well this is working, but it is a beginning that should be viewed as a first step in a process of phasing in pricing of water services as farmers economic strength increases.

ANNEX: WATER-SERVICE PRICING CONSIDERATIONS

The combination of a history of inadequate maintenance coupled with the precipitous termination of funding has resulted in deterioration of the water supply and delivery systems to the point that continuation of reliable service is in doubt. Each of the solutions presented in the previous section has an element that is common to all of them, --- the lack of adequate financing to implement the solutions.

As has already been said, there are three primary sources for financing, (1) the State Budget, (2) external financing, and (3) financial support from the water users. The first is a matter of governmental priorities. The second is limited and has previously stated constraints. This section deals with the third source: the pricing of water services which includes the basic purposes of water-service pricing, some criteria for equitable cost sharing among the beneficiaries, and a discussion of experiences other developing countries have had with water-service pricing.

Purposes for Pricing Water Services

It should be clear that any water-service pricing program is aimed at legitimate, useful purposes. There is general agreement that the three primary purposes for water pricing which are:

- Sustainability of services
- Conservation of water
- Mitigation of damages caused by water use

Sustainability of Services

Each Republic has invested a tremendous amount of resources in developing the infrastructure that is referred to as the water economy. That infrastructure consists of water supply, delivery, and drainage system facilities and the institutional organizations that must manage, operate, and maintain those facilities. That complex of facilities, with its attendant management organizations, constitute the “economic engine” that powers the economy of Turkmenistan. It is absolutely essential that the infrastructure of that system, both physical and institutional, be sustained at a level that ensures continued provision of those services in order to avoid severe hardships on society.

Actions that will bring that system up to a level of performance that will ensure sustainability of services can be accomplished by generating enough funds to support the needed actions. The source of such funds is not critical. They could come entirely from the state budget or entirely from the direct water users or some combination. However, if none comes from the direct water users there will be no incentive to conserve water and use it rationally.

Conservation of Water

It is possible that a charge for water services sufficient to sustain services would also encourage the needed level of conservation of water use. However, if the water charges

for sustainability of services are not sufficient to induce the desired level of water conservation, it will be necessary to impose an additional component of water-service pricing assigned specifically to the water users in order for them to feel the monetary impact of water use, which will encourage them to practice the desired level of conservation. There is evidence that irrigation practices employed in the Dashowuz Velayet result in considerable waste of water. Water-service pricing can be an effective instrument for encouraging more conservative practices.

Mitigation of Damages from Water Use

The purpose of this component of water pricing is to provide funding to mitigate or offset, at least in part, damages caused by the water use in question. This charge should be shared by all beneficiaries in proportion to the benefits received, which includes the general populace as well as the farmers.

CRITERIA FOR EQUITABLE COST SHARING

Economic Justification

There should be assurance that monies spent on the irrigation system are, in fact, associated with costs necessary for the operation, maintenance, and rehabilitation of that system, and nothing more than that. Of course, that includes support for organizations necessary for the management, operation, and maintenance of the water system. Expenditures for such legitimate purposes are deemed to be economically justified.

Economic Efficiency

Those management, operation, and maintenance actions should be done in the most economical way. That is, if the same action can be done as effectively and at less cost using some other method, it should be. If this criterion is followed, economic efficiency will be assured.

Economic Equity

Economic equity is assured if all beneficiaries share in the costs in proportion to the net benefits that they receive. This eliminates the possibility of one person or group realizing all of the gain or even a disproportionate share which was possible if only the economic justification and economic efficiency criteria were satisfied.

Acceptability

For any water pricing policy to succeed, it must be acceptable to the water users. If the economic justification, efficiency, and equity conditions are met, water users should be

willing to pay fair assessments. This is a sound theoretical presumption, but it does not necessarily reflect the more practical view of water users.

Water users generally do not know whether or not there is economic justification, efficiency, or equity. What farmers do know is what they observe, and what they observe is whether or not they receive an adequate supply of water at the places where it is needed at the times it is needed. If they do not receive such supplies of water, they generally will not be willing to pay.

In order for water users to view any water pricing policy as being acceptable, they must feel that they are receiving reliable service for the prices paid and that the prices paid are clearly understood to represent cost of services rendered. Therefore, it is incumbent upon water supply managers to deliver water supplies, however limited, on a predictable and efficient basis. To do that, the water supply and delivery system must be in good operational condition.

INTERNATIONAL EXPERIENCE WITH WATER PRICING

Most countries that have publicly-operated water supply systems rely on some form of cost sharing from water users by implementing a water-service pricing policy. The pricing policy is usually designed to recover costs associated with providing the necessary services for making the water available to users rather than a specific charge for water.

Since it is inescapable that somebody pays all costs in one way or another, the balance of costs not covered by water charges is usually provided through the general treasury. This can, in large part, be justified as an equitable public contribution for the indirect benefits that accrue to the general public. Many feel that equity is established through the low-price food policies that many developing countries have carried out vigorously. However, these policies have often provided considerable benefit to consumers at the expense of farmers. In other words, the farmers are subsidizing the rest of society. That is likely the case in Turkmenistan.

A Selective Review of Water Pricing Practices

A review of water pricing practices in 20 developing countries with significant irrigation sectors indicates that all have water-pricing policies designed to recover some costs from the water users.[15] These countries have had limited success.

With respect to operations and maintenance costs, a summary of the 20 countries surveyed includes the following:

[15] The countries were Jamaica, Mexico, Peru, Brazil, Tunisia, Cyprus, Nigeria, Zimbabwe, Jordan, China, The Philippines, Ecuador, The Dominican Republic, Indonesia, India, Nepal, Thailand, Korea, Pakistan, and Morocco. The information was extracted from a variety of reports that had been developed under the aegis of the USAID and World Bank.

- Five imposed an annual extraction charge, which amounted to a license to extract water from the system. These water charges were in the range of 1 to 4 percent of total production cost.
- Ten made an attempt to recover at least some of the costs. The partial assessments varied from 15 to 70 percent of the total operations and maintenance requirement.
- Nine made an attempt to recover all of the costs.
- One recovered O & M costs indirectly.

Apparently only 10 of the twenty countries had explicit policies with respect to the recovery of capital investment costs. Of those 10, seven had explicit policies not to assess farmers for any part of the capital investment cost and three had policies to recover some of the investment cost.

Formal cost recovery policy does not necessarily reveal a complete picture of what actually takes place. For example, Thailand is reported to have a policy not to collect a charge for water-service. Yet, during the dry season when water is needed for rice cultivation, the government-controlled price of rice is reduced as much as 30 percent**.** This results in a significant hidden charge for water-service during the dry season that is likely much higher than would be required to encourage water-use efficiency if the charge were assessed directly on the service provided.

From this survey, we can see that charging for water-service is one thing – collecting the charges is another.

Mechanisms for Collecting Water Charges

This section deals with the advantages and disadvantages of methods for assessing charges that are applied throughout the world, with some case-to-case variation. These methods include:

- Fees according to the volume of water delivered. The fee might also vary by season.
- Fees according to the area served. For irrigation, the fee might vary by crop and by season.
- Pricing by shares.
- Local area taxing.

None of these mechanisms is perfect and it is likely that some combination will provide the most acceptable result.

<u>Volumetric Pricing</u>

This method is usually the one preferred by economists, since it is the one that offers the best opportunity for obtaining economic efficiency. Pricing water according to the quantity used makes water users give strong consideration to the cost of water as a factor in how much is used. This leads to more efficient use of water. Often a major problem with this approach in many developing countries is that there is no practical way to measure and monitor the diversion of water from the distribution system to the user. This might be the primary reason for the widespread use of area pricing as an alternative.

Area-Based Pricing

This approach involves pricing water according to locations of areas served, with minimal control of the amount of water supplied. If any semblance of efficiency and equity is to be achieved, this approach must be considered in light of the delivery system and the ability to control the amount of water diverted to users in different parts of each area. There is a need to limit the amount of water each user can obtain, especially in times of water shortage. Control in an irrigation scheme that uses area-based assessments is usually achieved through arrangements among farmers to alternate in skipping a turn or to cut back on the time allowed to receive water. Equity depends upon farmers' discipline in adhering to the control schedules.

There is a tendency in area-based assessments to apply uniform rates to all parts of the service area. However, there are very few, if any, large publicly operated irrigation systems in the world that can deliver water uniformly to all parts of a large service area without incurring a great deal of cost. This creates a dilemma. If the costs are incurred to ensure equal water delivery to distant points, equity suggest that these added costs be assessed on the distant farmers. However, the distant farmers are often not getting as reliable service as the farmers that are closer to the source of water. One solution would be to adjust the fees to approximate the services received, but this could add considerably to the complexity and cost of administration.

Pricing by Shares

This mechanism depends largely on the enforcement of tightly administered controls to deliver water in accordance with the number of shares held by each water user in the service area. It is, in effect, a variant of area-based pricing. It usually empowers administrators with a wide range of discretion that sometimes leads to abuse of power. The primary check against abuse is to have the managers responsible to a representative body of water users who participate in the development of the rules.

Local Area Taxing

It has already been said that costs should be shared in proportion to the benefits received. Also, it has been said that the general public receives benefits and, therefore, should share in the costs through contributions from the State Budget. However, residents of the local area often receive benefits from the irrigation system that are greater than those received by the general public on a per capita basis. It can be argued that recipients of such benefits should make an additional contribution through local taxing. Often this is implemented by imposing a land tax on the residents of the local area for the specific purpose of contributing to the support of the O&M of the irrigation system in proportion to the additional benefits received.

Factors in Selecting Mechanisms for Collecting Water Charges

Other countries have taken many factors into consideration in selecting mechanisms for collecting water charges.

Efficient Administration

The cost of administering the assessment and collection procedures should be a small and acceptable percentage of the receipts. No one is well served if the mechanism for collecting water-service charges is so complex that administration costs absorb a large percentage of the revenues collected.

Equitable Cost Sharing

Equitable cost sharing rests on the principle that those who benefit should bear the cost without the involvement of subsidies. Subsidies tend to distort the true incidence of costs and benefits. Administratively determined prices for farm inputs and outputs generally have subsidy characteristics. They are designed to provide someone somewhere in the economy with a cost less than would prevail under free market conditions. However, public participation in an equitably shared water system investment, where the shared costs are proportional to the shared benefits, should not be viewed as a subsidy. It is a mutually beneficial investment in a cooperative capital venture and, as such, if the costs are shared in proportion to the benefits received, there is no subsidy.[16]

Ease of Water User Comprehension

The mechanism should be easy to communicate and explain to the affected water users so that there is no misunderstanding about costs and benefits and the underlying equity. The water users should be convinced that the cost components of the water rate structure are included to ensure that the supply and delivery system can deliver a reliable supply of water to them in a timely manner on a continuing basis. They should also be convinced that there is no cost component included that does not contribute to providing such a water supply. The water users also should be convinced that the payments they make do, in fact, only go to covering the identified costs and are not diverted to some other purpose. This assurance can only be provided by a transparent mechanism of assessing charges and a method of holding those in authority accountable for misconduct.

Credible Accounting and Audit Procedures

Credible accounting and audit procedures are essential to maintain water users' trust. The administrative mechanisms set up by most governments to assess and collect water-user fees seldom protect the integrity of an agreed cost-sharing arrangement, equitable or otherwise. This is because public systems often do not respond effectively since governmental financial and operational restrictions usually limit the water system authority's control over funding and the use of the funds. As a consequence, many of the public irrigation authorities are neither efficient nor effective in assessing and collecting irrigation fees from users. In many cases collections are only a small part of the assessments, and in some cases the cost of collection exceeds the amount collected. This tends to disturb whatever equity might exist.

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[16] This is not to argue that the public should contribute to irrigation costs beyond a level that is commensurate with the public benefits. Up to that point, it seems like a legitimate and equitable role for the government to be in an economically viable joint venture with farmers on matters that have broad economic benefits.

Water Users Participation in Administering Cost Sharing

In many countries, for reasons of audit and control, collected water-service fees are passed through the public revenue and expenditure systems. In so doing, these funds run the risk of being siphoned off for other purposes.

To protect against such misuse of funds, another option sometimes suggested is a revolving fund to ensure that funds are there when needed. This type of fund is useful in situations where operations and maintenance costs can vary considerably from season to season due to storm damage, flooding, and other acts of human or natural origin. But even if trust funds were established under government auspices, they could be vulnerable to being diverted to other public uses.

Most individuals and cohesive groups act responsibly in their own self-interest. The simplest means to ensure that adequate funds are available for optimum operations and maintenance on government operated systems is to turn the entire responsibility over to water-user associations who would assess, collect, and deploy the funds in their own collective interest.